DYWIDAG-SYSTEMS INTERNATIONAL

DYWIDAG Prestressing Systems using Bars

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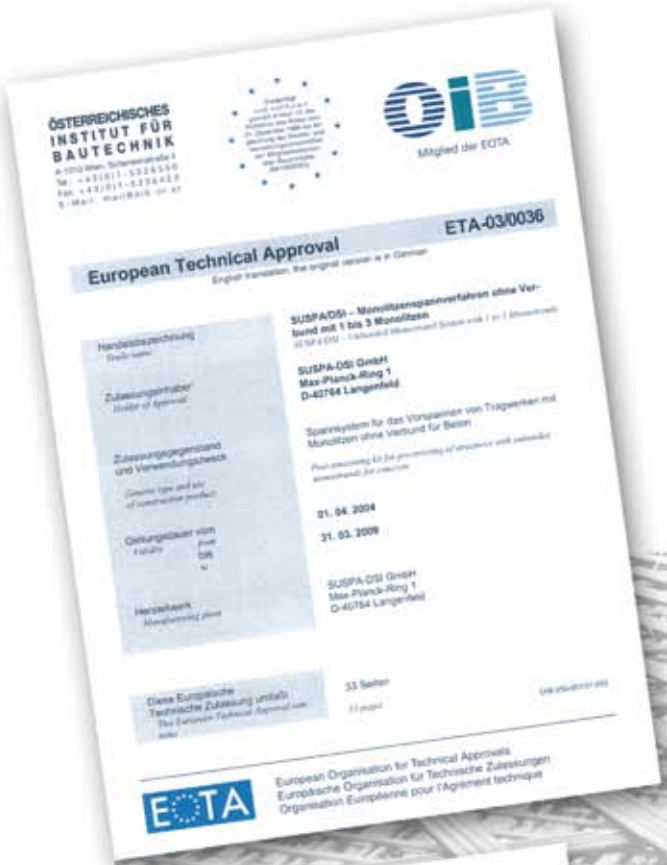
ETA Approvals

Construction products with an European Technical Approval (ETA) meet all essential demands given in the Construction Products Directive (CPD). The ETA holder is authorized to apply the CE-marking (ConformitÈ EuropÈenne) on his product. The CE-marking certifies the conformity with the technical specification and is the basis for the free movement of goods within the EU member states. DSI is proud to have European Technical Approvals for its PT-systems with bars, bonded strands and unbonded strands.


ÖSTERREICHISCHES INSTITUT FÜR BAUTECHNIK

Mitglied der EOTA

European Technical Approval ETA-03/0036

SUSPA/DSI – Monolitenspannverfahren ohne Verbund mit 1 bis 3 Monolitzen

SUSPA-DSI GmbH
Max-Planck-Ring 1
D-40764 Langenfeld

01. 04. 2004

31. 03. 2009

SUSPA-DSI GmbH
Max-Planck-Ring 1
D-40764 Langenfeld

33 Seiten

EOTA

European Organisation for Technical Approvals
Europäische Organisation für Technische Zulassungen
Organisation Européenne pour l'Agrément technique


Deutsches Institut für Bautechnik

DIBt

Mitglied der EOTA

European Technical Approval ETA-06/0022

DYWIDAG-Litzenspannverfahren mit nachträglichem Verbund

DYWIDAG-Systems International GmbH
Siemensstraße 8
85716 Unterschleissheim

DYWIDAG-Litzenspannverfahren mit 3 bis 37 Litzen (140 und 150 mm²) zur Vorspannung mit nachträglichem Verbund

12 January 2006

12 January 2011

DYWIDAG-Systems International GmbH
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85716 Unterschleissheim
DEUTSCHLAND

40 Seiten einschließlich 25 Anhänge

EOTA

Europäische Organisation für Technische Zulassungen
European Organisation for Technical Approvals


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European Technical Approval ETA-05/0123

DYWIDAG – Stahlspannverfahren

DYWIDAG-Systems International GmbH
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D-85609 Aschheim
Deutschland

Stahlspannsystem für das Vorspannen von Tragwerken, intern mit und ohne Verbund sowie extern

10.09.2005

10.09.2010

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60 Seiten, einschließlich 32 Anhängen

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System Description

Typical Coupling, Uhlavu Bridge, Pilsen, Czech Republic

DYWIDAG Prestressing Systems are world renowned for reliability and performance, most suitable for all applications in post-tensioned and prestressed constructions. They embrace the whole spectrum from bridge construction, buildings, to civil applications, above and underground.

The first ever structure built with a prototype DYWIDAG Post-Tensioning System using bars was the arch-bridge Alsleben (Germany) in 1927. From that time on DYWIDAG has continuously improved its systems to keep up with the growing demand of modern construction technology. In addition to the traditional post-tensioning system using bars, that is mainly geared towards geotechnical applications, building rehabilitation and strengthening, DSI offers a complete product line in strand prestressing (bonded, unbonded and external) as well as stay-cables being able to fully serve the post-tensioning construction. DYWIDAG Prestressing Systems have always combined highest safety and reliability standards with most economical efficiency in their research and development. Dependable corrosion protection methods of the DYWIDAG Prestressing Systems contribute to the longevity of modern construction. High fatigue resistance is achieved with optimized material selection and cautious detailing of all the components especially in their system assembly.

The bar systems for prestressed structure: bonded, unbonded and external tendons resp. are regulated in the European Technical Approval ETA-05/0123. This ETA can be downloaded at *www.dywidag-systems.com*.

For geotechnical applications a ground anchor with 47 mm threadbar diameter will be provided, too. A ∅ 47 mm threadbar prestressing tendon is in preparation. Additionally DSI-USA provides DYWIDAG Prestressing Systems with threadbars 65 and 75 mm.

The intended use for internal bar tendons is for concrete, composite and masonry structures. Internal unbonded and external bar tendons will be used for concrete, composite, steel, timber and masonry structures.

Typical applications are transversal prestressing, strengthening of bridges, rehabilitations, connection elements for steel structures and machines and temporary applications.

Uhlavu Bridge, Pilsen, Czech Republic

Prestressing bars and technical data

General

The prestressing bars are hot-rolled, tempered from the rolling heat, stretched and annealed, with a circular cross section.

The bars are of prestressing steel Y 1050 H according to prEN 10138-4.

The threadbars and plain bars are available in mill length up 18 m and may be cut to specified lengths before shipment to the jobsite.

Threadbars

Threadbars are available in diameters 26.5, 32, 36, 40 and 47 mm.

The threadbars feature continuous hot-rolled ribs providing a right-handed thread along the entire length.

The threadbar can be cut anywhere and is threadable without further preparation.

The threadbars are specified by nominal diameter and WR, e.g. 26 WR

Plain bars

Plain bars are available in diameters 32 and 36 mm.

Both ends of a plain bar cut to the length specified in the project are provided with special cold-rolled threads.

The thread lengths are manufactured in the shop according to the specifications of the project.

The plain bars are specified by nominal diameter and WS, e.g. 32 WS.

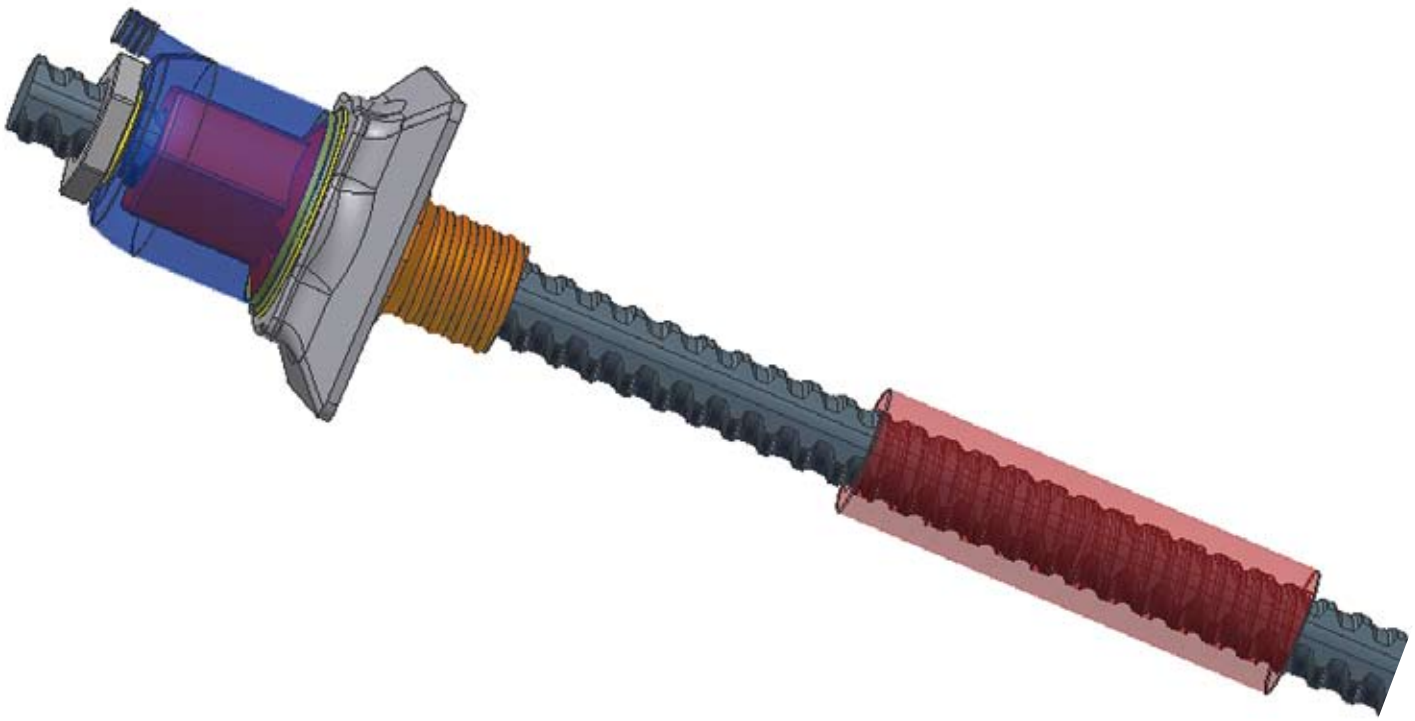
Technical data

			THREADBAR®					Plain bar	
Designation	–	–	26 WR	32 WR	36 WR	40 WR	47 WR	32 WS	36 WS
Nominal diameter	d_s	mm	26.5	32	36	40	47	32	36
Cross section area	S_n	mm²	552	804	1018	1257	1735	804	1018
Nominal mass per metre	M	kg/m	4.48[1)]	6.53[1)]	8.27[1)]	10.21[1)]	14.10[1)]	6.31	7.99
Pitch	c	mm	13	16	18	20	21	3.0	3.0
Characteristic breaking load	F_m	kN	580	845	1070	1320	1820	845	1070
Max. initial stressing force $P_{m0,max} = S_n \times 0.8 \times f_{p,k}$		kN	464	676	856	1056	1456	676	856
Max. overstressing force $P_{0,max} = S_n \times 0.95 \times f_{p0,1k}$		kN	499	722	912	1130	1567	722	912

1) The nominal mass per metre includes 3.5% not load bearing portion of ribs.

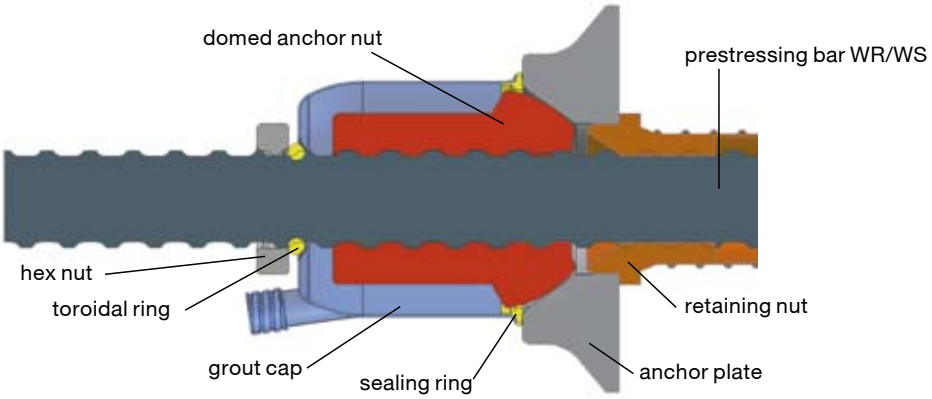
System overview

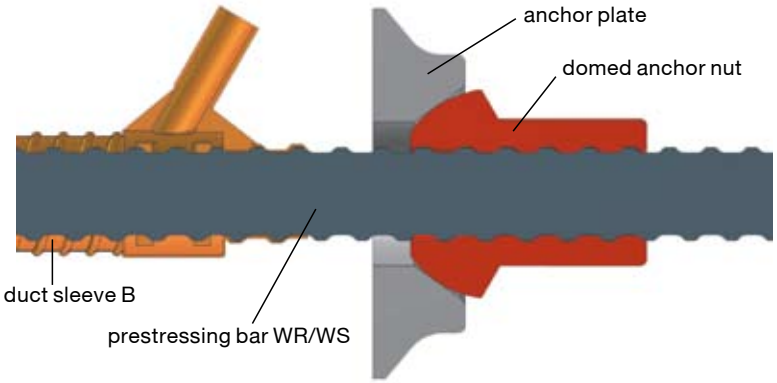
Available tendons		26 WR	32 WR	36 WR	40 WR	47 WR	32 WS	36 WS
Bonded bar tendon	QR-plate anchorage with additional reinforcement	■	■	■	■	■		
	QR-plate anchorage without additional reinforcement	N	■	■	■	■		
	Rectangular solid plate anchorage with additional reinforcement	■	■	■	■	■	■	■
	Rectangular solid plate anchorage without additional reinforcement	■	■	■	■	■		
	Square solid plate anchorage without additional reinforcement	■	■	■	■	■		
Unbonded and external bar tendon	Rectangular solid plate anchorage with additional reinforcement	■	■	■	■	■	■	■
	Square solid plate anchorage without additional reinforcement	■	■	■	■	■		



Overview of anchorages

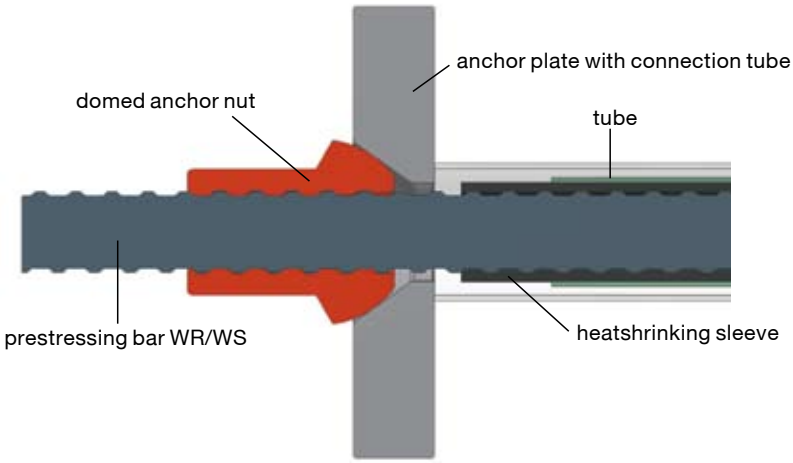
Stressing anchorage, bonded
The bar is fixed with the domed anchor nut and the retaining nut to the anchorage plate and this latter will be fixed to the scaffolding. The retaining nut provides the connection to the duct. Grouting is performed through the grout cap, the domed anchor nut with the three grout slots and the retaining nut.

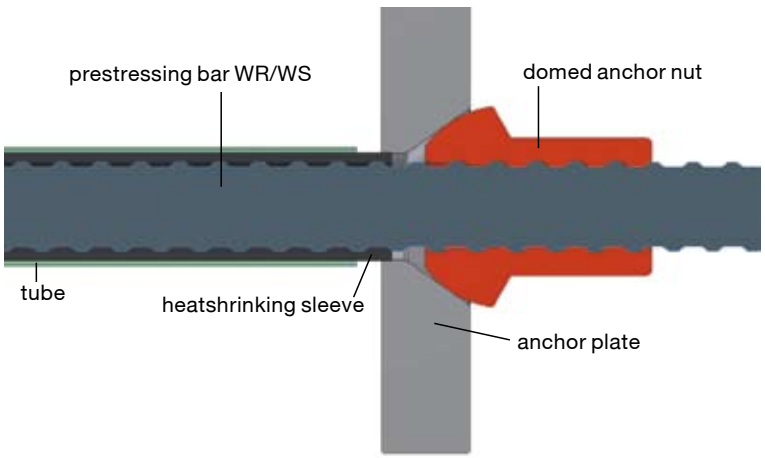




Fixed anchorage, bonded
The fixed anchorage is mostly completely embedded in the concrete. The domed anchor nut is tack welded perpendicularly onto the anchor plate. The duct sleeve B ends directly at the anchor plate the duct will be injected respectively vented there. A fixed anchorage can be designed as a stressing anchorage; the required bar-over length for the stressing can be dispensed.

Stressing anchorage, unbonded
Against water intrusion in the anchorage region a connection tube is welded to the anchor plate for bridging of a gap behind the anchor plate. Different corrosion protection systems are available.



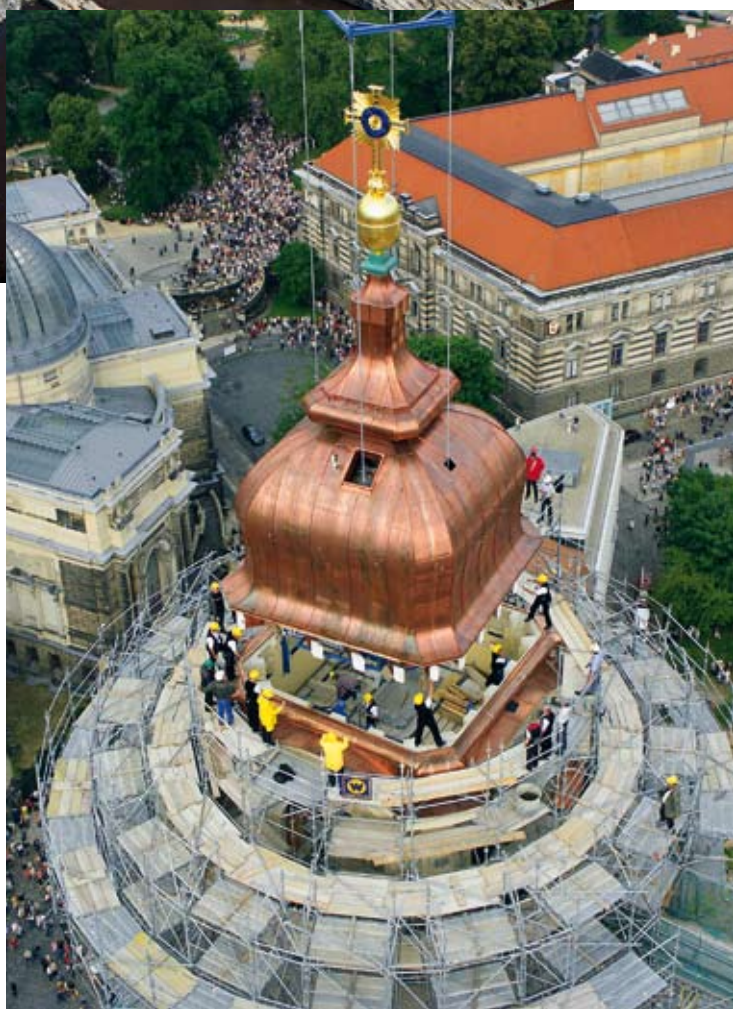


Fixed anchorage, unbonded
The fixed anchorage is mostly completely embedded in the concrete. The domed anchor nut is tack welded perpendicularly onto the anchor plate. The prestressing bar will be provided with the respective corrosion protection. The fixed anchorage can be carried out as an unbonded stressing anchorage, too.

Applications

Prestressing bar tendons can be used at new structures and for strengthening of existing structures, as longitudinal or transversal tendons, as shear reinforcement, straight or curved, as hangers at concrete or steel arch bridges, for temporary or permanent connections of precast concrete elements, fixations of concrete to concrete, new concrete to old concrete, steel to concrete, concrete to masonry or any combination of members made of any structural material.

Grand-MÈre Generating Station, Canada



Church of Our Lady, Germany

Overview bonded bar tendons

Bonded bar tendons are embedded in concrete. The corrosion protection of the prestressing steel and the bond with the structural concrete is provided by grout injected in the ducts.

A bonded tendon is intended to be used for concrete, composite and masonry structures.

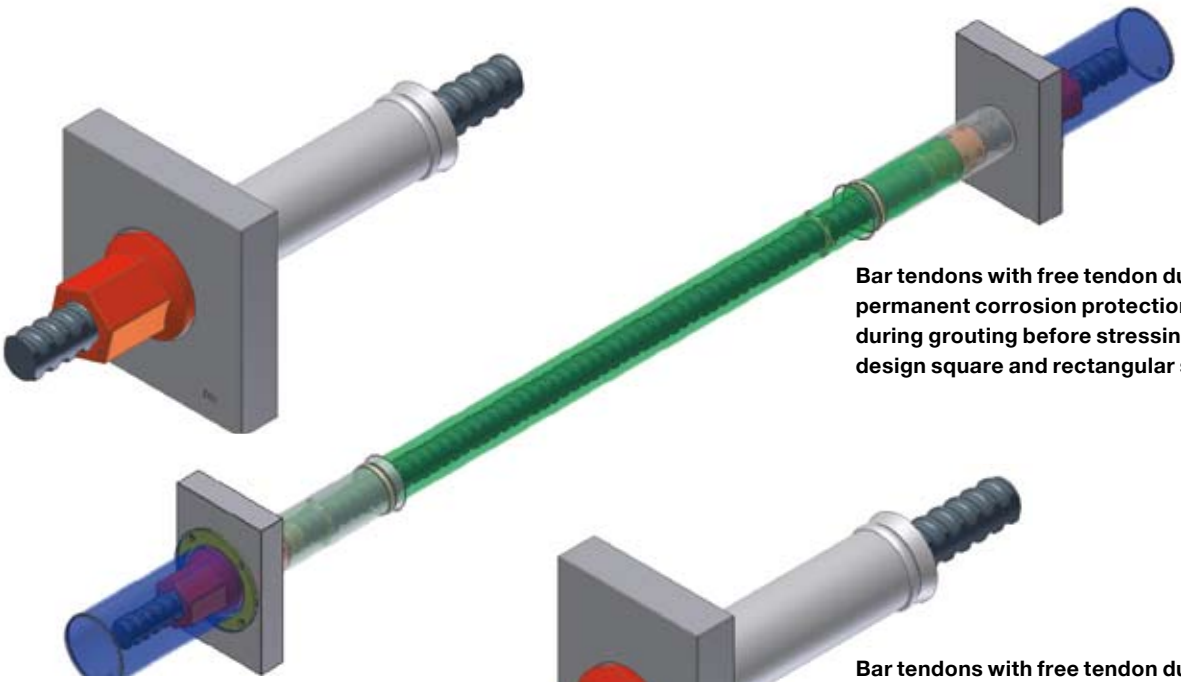
Bonded bar tendon, design QR-plate, square and rectangular solid plates

Overview unbonded and external bar tendons

Unbonded and external bar tendons are installed either inside or outside the cross section of the structure. For corrosion protection various systems are available, all of which do not bond with the structure. The tendons may be restressed at any time and depending on the tendon type, they can also be removed or exchanged.

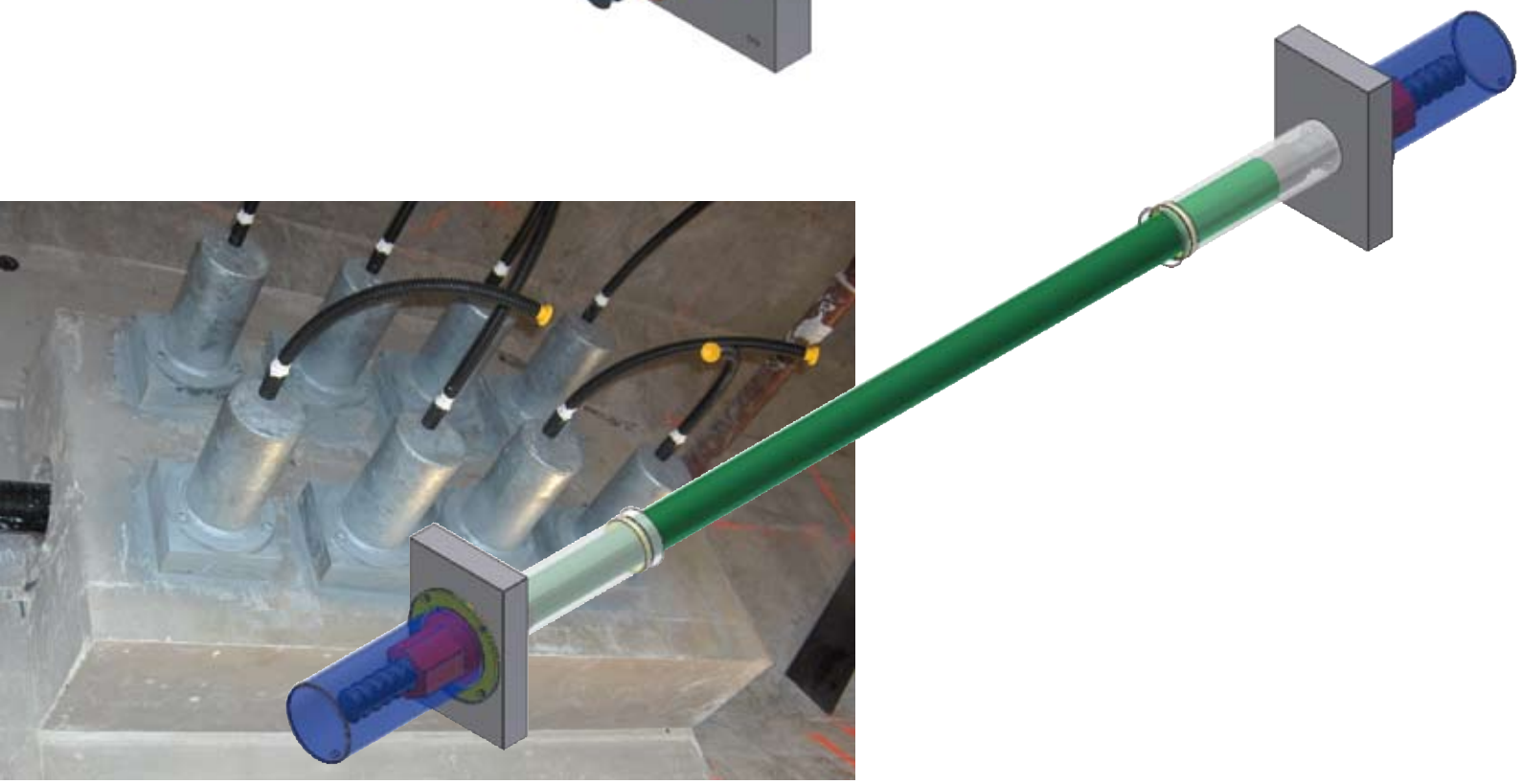
Internal unbonded and external tendons are intended to be used for concrete, composite, steel, timber and masonry structures.

The corrosions protection of unbonded and external tendons depends on an environmental conditions and service time.



Bar tendons with free tendon duct, permanent corrosion protection executed during grouting before stressing, design square and rectangular solid plates

Bar tendons with free tendon duct, permanent corrosion protection executed by heatshrinking sleeve, design square and rectangular solid plate



Geometrical characteristics of accessories

Bar designation			Threadbar 26 WR	32 WR	36 WR	40 WR	47 WR	Plain bar 32 WS	36 WS
Domed anchor nut	length	[mm]	75	90	100	115	135	46	60
	width across flat	[mm]	50	60	65	70	80	55	65
Coupler (standard)	length	[mm]	170	200	210	245	270	110	160
	outside diamter	[mm]	50	60	68	70	83	60	68
Square solid plate	width	[mm]	150	180	200	220	260	-	-
	length	[mm]	150	180	200	220	260	-	-
	thickness	[mm]	35	40	45	45	50	-	-
Rectangular solid plate (unbonded and bonded)	width	[mm]	130	140	150	160	-	140	150
	length	[mm]	150	180	220	250	-	180	220
	thickness	[mm]	35	40	50	60	-	40	50
QR-plate	width	[mm]	120	140	160	180	-	-	-
	length	[mm]	130	165	180	195	-	-	-
	thickness	[mm]	30	35	40	45	-	-	-
Corrugated duct	internal diameter	[mm]	38	44	51	55	65	44	51
	outside diameter	[mm]	43	49	56	60	70	49	56
Minimum bar protrusion		[mm]	80	90	100	115	125	50	65
Rectangular solid plate (bonded)	width	[mm]	120	140	160	180	-	-	-
	length	[mm]	130	165	180	195	-	-	-
	thickness	[mm]	30	35	40	45	-	-	-

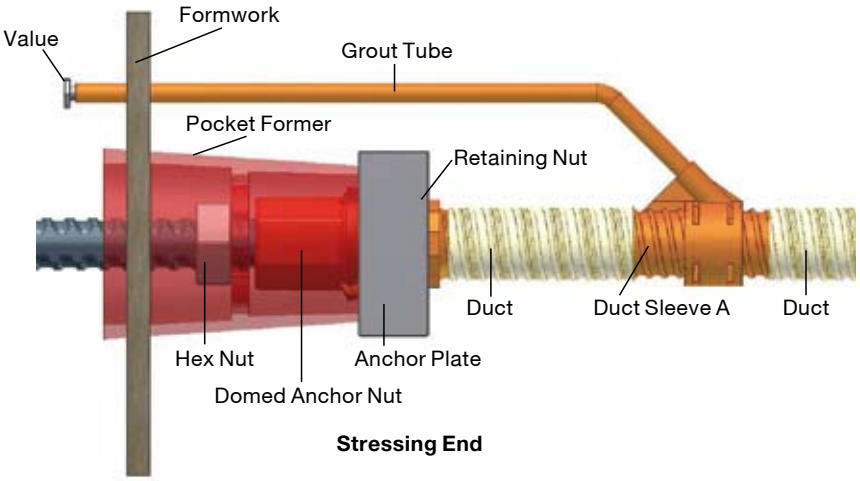
Overview of tensioning jacks for prestressing Tendons

Bar designation	Threadbar 26 WR	32 WR	36 WR	40 WR	47 WR	Plain bar 32 WS	36 WS
60 Mp	x	x[1]				x[1]	
110 Mp	x	x	x	x		x	x
200 Mp					x		

1 stressing force limited to 625 kN max.

Installation

DYWIDAG-SYSTEMS INTERNATIONAL offers a full line of special installation accessories to facilitate field assembly and installation. Installation shall be carried out by properly trained and experienced personnel. Tendons can be delivered to the jobsite prefabricated when desired (e.g. unbonded bar tendon), too.



Stressing End

In the area of anchorage adequate space shall be accomplished through a pocket former assembled at the formwork before concreting in order to put on the jack and for the grout cap.

Woodrow Wilson Bridge, Washington, D.C., USA

Jeju Port Extension, South Korea

Stressing and grouting

The small, light and conveniently operated DYWIDAG-SYSTEMS INTERNATIONAL jacks facilitate the stressing operation. Heavy lifting aids are generally not necessary. The jack is pushed over a pull rod coupler that is threaded onto the bar protrusion behind the domed anchor nut. The jack is then fixed with a pulling nut. The tension load is hydraulically transferred. The domed anchor nut is tightened by an internal wrench. The bar 47 WR has a specially equipped stressing jack.

Stressing notes
Straight tendons are generally stressed from one end only. In order to reduce friction losses (especially in draped tendons) it is recommended to stress from both sides.

The prestressing load can be adjusted up and down at any given time until the tendon is fully grouted by simply reinstalling the jack. This allows partially stressing. Several controls during and after the stressing operation check the effective stressing load:

- bar protrusion at the anchorage before and after stressing to evaluate the effective elongation
- counter control for elongation during stressing operation
- gauge control for hydraulic pressure

To comply with exceptional high demands on accuracy for example on very short tendons special accessories can be applied to minimize the influence of alignment tolerances.

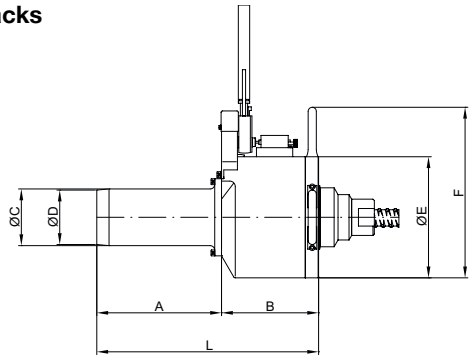
Grouting
The durability of bonded post-tensioned construction depends to a great degree on the success of the grouting operation. The hardened cement grout provides bond between concrete and tensile elements as well as primary long term corrosion protection (alkaline medium) for the prestressing steel.

DYWIDAG SYSTEMS INTERNATIONAL has developed a grouting operation that is based on highly plasticized grout with thixotropic properties, and utilizes durable grouting equipment. Advanced methods such as pressure grouting, post-grouting and vacuum grouting are all results of many years of development.

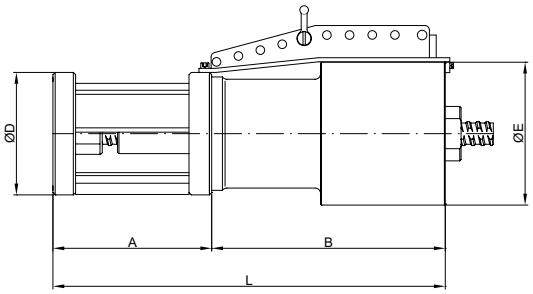
Grouting is always done from a low-point of the tendon. This can be one of the anchorages with a grout cap with grout inlet or along the tendon utilizing an intermediate grout saddle. All grouting components are threaded for easy, fast and proper connection.

Equipment for stressing and grouting

Tensioning jacks



Tensioning jack 110 Mp/60 Mp



Tensioning jack HOZ 200 Mp

Dimensions (for Block-Out design)

Tensioning jacks	L	Ø E	stroke	piston area Ak	capacity	max. piston pressure	weight	A	B	Ø C	Ø D	F
	[mm]	[mm]	[mm]	[cm²]	[kN]	[bar]	[kg]	[mm]	[mm]	[mm]	[mm]	[mm]
60 Mp Series 04	401	190	50	132.5	625	50	36	225	176	3)	3)	300
60 Mp Series 05	456	190	100	132.5	625	50	44	225	231	3)	3)	300
110 Mp Series 01	494	267	50	235.6	1100	50	46	275	219	4)	4)	375
110 Mp Series 03	594	267	150	235.6	1100	50	54	275	319	4)	4)	375
200 Mp	865	315	150	361.3	2000	60	172	350	515	-	270	-

	Ø C	Ø D	for type of bar
	[mm]	[mm]	
3)	105	106	26 WR, 32 WS
	135	114	32 WR
4)	122	106	26 WR
	125	110	32 WS
	125	120	32 WR, 36 WR/WS
	134	134	40 WR

Pump Type 77-193 A

Pump Type R 6.4

Hydraulic pumps

Hydraulic pumps	Tensioning jacks		
	60 Mp	110 Mp	200 Mp
77-193 A	■	■	
R 3.0 V	■	■	
R 6.4	■	■	■

Pump type	max. operating pressure	oil flow rate	usable oil capacity	weight with oil[1]	dimensions L x W x H
	[bar]	[l/min]	[l]	[kg]	[mm]
77-193 A	600	3.0	10	63	420x380x480
R 3.0 V	600	3.0	13	98	600x390x750
R 6.4	600	6.4	70	310	1400x700x1100

1) hydraulic pumps will be supplied without oil

Mixer MP 2000-5

Grouting equipment (mixing and pumping)

Grouting equipment	max. injection pressure	capacity	weight	dimensions L x W x H
	[bar]	[l/h]	[kg]	[mm]
MP 2000-5	15	420	300	2000x950x1600

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